Environmental Assessment for Project Partnership Transportation of Foreign-Owned Enriched Uranium from the Republic of Georgia

LIST OF TABLES

U.S. DEPARTMENT OF ENERGY

Office of Nonproliferation and National Security

FINDING OF NO SIGNIFICANT IMPACT

TRANSPORTATION OF FOREIGN-OWNED ENRICHED URANIUM FROM THE

REPUBLIC OF GEORGIA

"PROJECT PARTNERSHIP"

AGENCY: United States Department of Energy

ACTION: Finding of No Significant Impact (FONSI) for Project Partnership.

Transportation of Foreign-Owned Enriched Uranium from the Republic of Georgia to the United Kingdom

SUMMARY:

The Department of Energy (DOE) has prepared a classified environmental assessment (DOE/EA-1255, March 1998) to evaluate the potential environmental impact for the transportation of 5.26 kilograms of enriched uranium-23 5 in the form of nuclear fuel, from the Republic of Georgia to the United Kingdom. The nuclear fuel consists of primarily fresh fuel (fuel that has never been used in a reactor), but also consists of a small quantity (less than 1 kilogram) of partially-spent fuel (fuel that has been partially used, but not completely spent). Transportation of the enriched uranium fuel would occur via United States military aircraft. Actions taken in the sovereign nations of the Republic of Georgia and the United Kingdom

are not subject to analysis in the environmental assessment. However, because the action would cross the global commons of the Black Sea and the North Sea, the potential impact to the human environment has been analyzed for actions occurring in and over the global commons.

Based on the analyses in the environmental assessment, the Department has determined that the transportation of approximately 5 kilograms of uranium-235 in the form of nuclear fuel via United States military aircraft from the Republic of Georgia to the United Kingdom does not constitute a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act. Therefore, an environmental impact statement is not required and the Department is issuing this Finding of No Significant Impact.

ADDRESSES AND FURTHER INFORMATION:

Persons requesting additional information regarding this action or desiring a copy of the environmental assessment should contact:

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The Environmental Assessment and this Finding of No Significant Impact will be declassified and made available for public review as soon as possible at the public reading room at DOE headquarters:

U.S. Department of Energy
Freedom of Information Reading Room
Forrestal Building, Room lE - 190
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SUPPLEMENTARY INFORMATION

Background:

The United States supports a policy of nuclear nonproliferation. This policy goal is shared by other countries such as the Republic of Georgia and the United Kingdom. Accordingly, the leaders of three countries entered into a partnership to protect enriched uranium fuel at the now closed Institute of Nuclear Physics in Tbilisi, Georgia. The Tbilisi research facility has been permanently shut down since 1988, is in a poor state of repair, and is not capable of providing adequate physical security for the enriched uranium. In May 1996, DOE provided the Tbilisi facility with interim security upgrades to help better protect the enriched uranium fuel, but these measures were not designed for long-term protection. Therefore, in 1998, the President of the United States, the Prime Minister of the United Kingdom, and the President of the Republic of Georgia entered into a partnership to relocate the Georgian enriched uranium to the United Kingdom. DOE was tasked to oversee the repackaging of the material and to work with the Department of Defense (DoD) to transport the material to the United Kingdom. DOE has therefore prepared this environmental assessment to evaluate the potential environmental impacts of this action on the global commons.

The analysis is the Project Partnership Environmental Assessment was based on a previous action taken by DOE in 1994, called Project Sapphire. Project Sapphire was a similar action which relocated a substantially larger quantity of enriched uranium fuel (566 kg) from the Republic of Kazakhstan to the United States for interim storage and processing to low enriched uranium for use as commercial nuclear fuel. Because of the similarities in the two actions, the Project Sapphire Environmental Assessment (DOE/EA-1006) was used as a basis for assessing the potential impacts of Project Partnership. However, because Project Partnership involves a small quantity of partially-spent fuel, additional analysis was conducted to assess the potential environmental impacts and to consider reasonable alternatives to the proposed action.

Proposed Action:

The proposed action is the transportation of approximately 5 kg uranium via U.S. military aircraft from the Tbilisi, Republic of Georgia to Dounreay, Scotland in the United Kingdom for secure storage. The uranium-235 consists of less than 5 kg uranium-235 (^{235}U) in the form of fresh fuel (fuel which has not been used or irradiated in the Tbilisi research reactor) and less than 1 kg of partially-spent fuel. Enriched uranium would be removed from the current storage location at the research reactor in Tbilisi, repackaged for safe and secure transport, and transported by military C-5 or C-17 aircraft to the United Kingdom in Scotland. DOE would oversee the repackaging and transportation of the material; however all actions would occur in and between foreign countries. None of the material would be returned to the United States and no physical project would be constructed in a foreign country. The United Kingdom would assume responsibility for the fuel once in their possession.

The enriched uranium to be relocated is in the form of small fuel rods and pins.

The Georgian enriched uranium would require repackaging prior to transport because the Georgian containers currently used to store the material do not meet requirements for international transport. Repackaging would ensure a nuclear criticality safe configuration for the enriched uranium fuel rods. The partially-spent fuel would be packaged in a separate cask approved by the US Nuclear Regulatory Commission and which would meet international shipping requirements. The repackaging operations would require approximately 20 DOE and contractor personnel. Actions that would occur on the ground in Georgia (such as repackaging and loading/unloading operations) would be conducted with the full cooperation and involvement of the governments of Georgia and the United Kingdom. These actions conducted in the sovereign nations are not subject to further analysis in this environmental assessment.

For the purposes of this environmental assessment, the proposed action begins in the air over the global commons at the boundary of the Republic of Georgia and the Black Sea and concludes with the entry into United Kingdom airspace over Scotland.

The enriched uranium would be transported from Tbilisi, Georgia to Scotland by one United States military C-17 aircraft under control of EUCOM and approximately 3 Department of Defense personnel. A second C-17 would transport material and equipment needed to support the repackaging and loading/unloading operations. EUCOM may wish to use one C-5 aircraft instead of the two C- 17s. Under this alternative, an additional C- 141 may also be needed for support equipment. Use of either type of aircraft is considered in the environmental assessment along with a crew size that could vary from three to 30 personnel.

Because of the similarities in this action and Project Sapphire, the scope of the two projects was compared. The primary differences include the, quantity of material and the storage destination. Project Partnership involves transport of less than 1% of the quantity of enriched uranium transported under Project Sapphire. Project Partnership involves no action inside the United States whereas Project Sapphire br9ught the enriched uranium back to the United States for interim storage (where it was eventually processed into low enriched uranium for use a commercial nuclear fuel.) Both Projects Sapphire and Partnership involve nuclear fuel. However, one difference is the inclusion of a small quantity of partially spent fuel in Project Partnership. This quantity is less than 1/5 of the total amount of enriched uranium that would be transported. However, because Project Sapphire did not involve partially spent fuel, additional analysis was provided to assess the potential impacts to the crew and the global commons.

Environmental Impacts:

The Project Partnership Environmental Assessment evaluated potential impacts to the human environment under both normal operations and a bounding accident scenario.

Normal Operations - Under normal operations, several alternatives could be selected by EUCOM including a long or short flight path (from 2,650 miles to 5,260 miles), and a varying crew size (from 3 to 30 personnel). The proposed action is the use of a small crew (three personnel) over the most direct (short) route. However, for the purposes of the environmental assessment, a range of alternatives was considered. Following is a summary of the potential environmental impacts. For impacts of normal operations, two sets of data are presented: the first data set is for the desired action (a small crew over the short route); and the second data set is for the bounding case action under normal operations (a large crew over a long route).

For the proposed action of the transport of 5 kg enriched uranium using a small crew over the most direct flight path, the collective dose to three crew members would be 0.012 person-rem. Using the dose-to-risk conversion factor of $4 \times 1\ 0^{-4}$ latent cancer fatalities, the collective dose of 0.012 person-rem would result in a probability of 4.9×10^{-6} latent cancer fatalities. This means that the three crew members would face a collective risk of about five chances in one million of suffering a fatal cancer later in their life as a result of this action. Under a bounding case for normal operations using a larger crew and traversing a longer flight path, the collective dose to the 30-person crew would be 0.247 person-rem. Using the dose-to-risk conversion factor of $4 \times 1\ 0^{-4}$ latent cancer fatalities, the collective dose of 0.247 person-rem would result in a probability of $9.89 \times lO^{-5}$ latent cancer fatalities. This means that the thirty crew members would face a collective risk of about 10 chances in one hundred thousand (100,000) (or one chance in ten thousand) of suffering a fatal cancer later in their life as a result of this action. Because these probabilities are less than 1.0, it is likely that not even a single person would die from a latent cancer caused by this action.

In incident-free conditions, radiological exposure would only result to the crew on board the aircraft; there would be no radiological exposure to the public or the global commons.

For comparison, these risks are about one to two orders of magnitude less than that for Project Sapphire. The Finding of No Significant Impact for the Project Sapphire Environmental Assessment concluded that a collective dose of 0.34 person-rem to 30 crew (which would result in an associated latent cancer fatality probability of 1.4×10^{-4}) would not be significant since not a single crew member would be expected to die from a latent cancer induced by this small exposure.

Since the action under Project Partnership would result in an even smaller collective dose and smaller probability of a latent cancer fatality, the impact to the crew from this action is determined not significant.

Accident Conditions - Potential impacts to the global commons of the Black Sea and the North Sea were also assessed. Under incident-free conditions, non-radiological air emissions of criteria air pollutants from the aircraft operations would fall well below US Environmental Protection Agency EPA) threshold levels and would not have a measurable effect on the global commons of the air. This determination is support by the Finding of No Significant Impact for Project Sapphire which concluded negligible effects on the global commons from the operation of the C-5 aircraft flight over a flight distance of 8,000 miles. Since this action under Project 'Partnership would involve approximately one-third to two-thirds the flight distance of Project Sapphire, the impacts to the global commons would likewise not be significant.

Potential impacts for a bounding case accident scenario were also analyzed. A bounding case accident scenario would involve an in-flight crash of the military aircraft such that the containers of enriched uranium fuel would be breached and the enriched uranium released into the water of the global commons (the Black Sea or the North Sea). As documented in the Project Sapphire Environmental Assessment, in-ifight accidents would have a higher probability of container breach than landing/stall accidents. Further, for the global commons, only in-flight accidents probabilities are applicable because no landings would occur in the commons. Salvage techniques are assumed to allow for recovery of packages at depths of up to 200 meters. Should an unbreached package sink below 200 meters, long-term containment would be expected due to the low corrosion rates of the stainless-steel used in the package's construction. However, the bounding accident scenario assumes the containers would breech and the enriched uranium released. In the Black Sea the anoxic conditions below 200m would accelerate corrosion of the uranium. However, since there is no life in this zone of the Black Sea (due to the lack of oxygen), no effects to marine organisms would be expected. In the North Sea, which is more shallow and more turbulent than the Black Sea, the volume of water and the well-mixed conditions in the shallow sea would disperse the uranium such that effects would be localized and short-term, although there may be some fatalities to marine species in the localized area of the accident. The small quantity of plutonium would be expected to preferentially bind with the bottom sediments.

In an accident scenario, only the crew and the global commons would be affected. There would be no exposure to the public.

The environmental assessment for Project Sapphire examines this bounding case accident scenario for a much larger quantity (566 kg) of enriched uranium. For Project Sapphire, the probability of the accident occurring in-flight was estimated to be 6.7×10^{-10}. This is a bounding conservative probability (overestimation) based on a severe case accident where the impact forces exceed standards and fire engulfs the plane for more than 30 minutes causing 70% of the packages to fail.

Based on these assumptions for a bounding case accident scenario, the Project Sapphire Finding of No Significant Impact concludes there may be some loss of life to marine organisms directly exposed to the enriched uranium in this hypothetical bounding case scenario. However, as a result of the large volumes of water, the mixing mechanisms within it, the existing background concentrations of uranium, and the radiation-resistance of aquatic organisms, the radiological and toxicological impact of a very low probability accident would be localized and of short duration. The potential impacts of less than 5 kg enriched uranium from Project Partnership would be substantially less than Project Sapphire and are therefore determined to be not significant.

Summary Conclusions - In summary, use of a small crew (over a short or long flight path) would result in a collective radiological dose of about 95% less than that from Project Sapphire. Use of a large crew (over a short or long flight path) would result in a collective radiological dose ranging from 27% to 65% less than that of Project Sapphire. The risk probability of incurring a fatal cancer later in life as a result of these actions would be one to two orders of magnitude less than that for Project Sapphire. Not a single person would be expected to suffer a fatal cancer later in life as a result of this action. It is also unlikely that the global commons would be adversely affected.

ALTERNATIVES:

Because of the decision of the President of the United States and the leaders of the United Kingdom and the Republic of Georgia to relocate the enriched uranium from Georgia to the United Kingdom, the only alternatives available for further consideration include the transport mode and route. Potential impacts from these alternatives were discussed above.

An alternative transportation route could involve traversing a longer flight path over the global commons of the Mediterranean Sea and the Atlantic Ocean. While this route would pass over fewer countries, the route would be' about twice as long which would result in a doubling of the radiological doses received by the transport crew. This dose would still be less than that of Project Sapphire. Analysis of this alternative is provided in the environmental assessment.

The transportation mode could involve military transport by United States Navy ships over the global commons, however, this mode would require longer time than air transport. Because this increased time would further increase the radiological dose, and because the governments of the United Kingdom and the Republic of Georgia have expressed a need to relocate the enriched uranium as quickly as possible, naval transport was not considered as an alternative that would meet the purpose and need for action and was therefore not analyzed in detail.

Under the No Action alternative, the enriched uranium would be left in place at Tbilisi with no additional security measures. Because of the unreliable electrical supply, political unrest, and poor security conditions at the facility, this alternative could result in theft or unauthorized access to the enriched uranium.

DETERMINATION:

Based on the analyses in this Environmental Assessment (DOE/EA-1255) for Project Partnership, and based on the previous Environmental Assessment (DOE/EA- 1006) and Finding of No Significant Impact for Project Sapphire, the Department of Energy has determined that the transportation of about 5 kg of enriched uranium nuclear fuel from the Republic of Georgia to the United Kingdom does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement is not required.

/original signed by Rose E. Grottemoller

Director
Office of Nonproliferation and National Security

Environmental Assessment

for

Project Partnership

Transportation of Foreign-Owned Enriched Uranium

from the

Republic of Georgia

March 1998

U.S. Department of Energy (DOE)

Office of Nonproliferation and National Security (NN)

ACRONYMS

CFR	United States Code of Federal Regulations
Ci	curie
CRT	cargo restraint transporter
DOE	United States Department of Energy
DOT	United States Department of Transportation
EA	environmental assessment
EPA	United States Environmental Protection Agency
EUCOM	United States Department of Defense European Command
FONSI	finding of no significant impact
ft	foot
HEU	highly enriched uranium
IAEA	International Atomic Energy Administration
in	inch
kg	kilogram
LEU	low enriched uranium
mi	mile
mm	millimeter
MT	metric ton
NAC	Nuclear Assurance Corporation, International
NEPA	National Environmental Policy Act of 1969
NRC	United States Nuclear Regulatory Commission
NSC	National Security Council
pCi/l	picocuries per liter

Executive Summary

Pursuant to the requirements of the National Environmental Policy Act (NEPA) and the DOE NEPA Implementing Regulations at 10 CFR 1021 and in accordance with DOE Order 451.1 A, the Department of Energy (DOE) Office of Nonproliferation and National Security (NN) has prepared a classified environmental assessment (DOE/EA-1255, March 1998) to evaluate the potential environmental impact for the transportation of 5.26 kilograms of enriched uranium-235 in the form of nuclear fuel, from the Republic of Georgia to the United Kingdom. The nuclear fuel consists of primarily fresh

fuel, but also consists of a small quantity (less than 1 kilogram) of partially-spent fuel. Transportation of the enriched uranium fuel would occur via United States Air Force military aircraft under the control of the Defense Department European Command (EUCOM). Under NEPA, actions taken in a sovereign nation (such as the Republic of Georgia and the United Kingdom) are not subject to analysis in the environmental assessment. However, because the action would involve the global commons of the Black Sea and the North Sea, the potential impact to the global commons has been analyzed.

The analysis in the Project Partnership Environmental Assessment was based on and bounded by a previous action taken by DOE in 1994, called Project Sapphire. Project Sapphire was a similar action which relocated a substantially larger quantity of enriched uranium fuel (566 kg) from the Republic of Kazakhstan to the United States for interim storage and processing to low enriched uranium for use as commercial nuclear fuel. Because of the similarities in the two actions (Table ES-1), the Project Sapphire Environmental Assessment (DOEIEA-1006) was used as a basis for assessing the potential impacts of Project Partnership. However, because Project Partnership involves a small quantity of partially-spent fuel, additional analysis was conducted to assess the potential environmental impacts and to consider reasonable alternatives as required by NEPA.

The Project Partnership Environmental Assessment found the potential environmental impacts to be well below those from Project Sapphire as shown in Table ES-2. The radiological dose to the crew on the aircraft would range from 27% to 96% less than Project Sapphire depending on the crew size and the length of the flight path. Under the preferred option of a small crew and a direct flight path, radiological doses would range from 93% - 96% less than Project Sapphire. Impacts to the global commons of the Black Sea and the North Sea would be localized, but negligible in the unlikely event of an accident. No members of the public would be adversely affected by this action.

Based on the analysis in the environmental assessment, and because the potential environmental impacts are less than those of Project Sapphire (which received a Finding of No Significant Impact determination), potential environmental impacts of Project Partnership are likewise believed to be not significant within the context and meaning of the National Environmental Policy Act.

Table ES-1. Comparison of Scope of Project Partnership with Project Sapphire

Table ES-2. Comparison of Potential Environmental Impacts of Project Partnership with Project Sapphire

1.0 PURPOSE AND NEED FOR ACTION

1.1 Nonproliferation Objective

On September 27, 1993, President Clinton established the United States' Nonproliferation and Export Control Policy which seeks to make nonproliferation an integral element of our relations with other countries, and seeks to eliminate the accumulation of stockpiles of highly enriched uranium. The President established the objective of implementing the United States nonproliferation policy by selectively acquiring fissionable material from foreign sources in order to reduce the likelihood of nuclear weapons proliferation (White House 1993).

1.2 Discovery of Enriched Uranium in the Republic of Georgia

In January, 1996, during a visit to the Institute of Nuclear Physics in Tbilisi, Georgia[1], a U.S. Department of Energy (DOE) material protection control and accounting team[2] discovered approximately 4.45 kg of uranium-235 (^{235}U) contained in highly enriched uranium (HEU) and low enriched uranium (LEU) fresh nuclear fuel[3]from the permanently shutdown IRT-M research reactor. In addition, the team found approximately 1 kg of HEU (90% enriched in ^{235}U) in partially-spent fuel.

The Tbilisi reactor facility was permanently shut down in 1988 and is in a poor state of repair and is not able to provide for strong safeguards of its enriched uranium. In May, 1996, a DOE physical protection team completed interim physical protection upgrades, including an alarm system, television surveillance cameras and a brick barrier. These interim measures were temporary and were not designed to provide for long-term physical security (Riedy 1996).

1.3 Decision to Relocate the Enriched Uranium

In 1998, the leaders of three nations entered into a partnership agreement for actions to address the need for increased protection of the Georgian enriched uranium. President Clinton of the United States, Prime Minister Blair of the United Kingdom, and President Schevardnadze of the Republic of Georgia decided that the Georgian enriched uranium would be relocated to the United Kingdom as soon as possible. The United States Department of Defense, (DoD), the US Department of State, and the National Security Council authorized DOE to participate with the DoD European Command (EUCOM) in the transportation of the Georgian enriched uranium to the United Kingdom.

The action over which DOE has responsibility in this project is the packaging, handling, and transportation of the enriched uranium to move it from the Republic of Georgia to safe storage in the United Kingdom. This environmental assessment (EA) analyzes the impacts of transp9rting the enriched uranium over the global commons of the Black Sea and the North Sea.

1.4 Related Actions

In the 1994, DOE participated in a similar action known as Project Sapphire in which 566 kilograms (kg) *(0.566* metric tons (MT)) of HEU were transported from the Republic of Kazakhstan to the United States for interim storage at the Oak Ridge Y-12 Plant.[4] DOE prepared a classified environmental assessment (DOE/EA- 1006) in October 1994 for the transportation of HEU from Kazakhstan to the Y-12 Plant which resulted in a Finding of No Significant Impact (FONSI) in October 1994.[5] Both the environmental assessment and FONSI for Project Sapphire have since been declassified.

The analysis in the Sapphire EA, as documented by the FONSI, concluded that there would be no significant impact to the global commons from the transport of 566 kg HEU from Kazakhstan to the United States with consideration for both normal operations and accident scenarios.

Because of the similarities in the action under Project Sapphire as compared with the action proposed under Project Partnership, the analysis in the Sapphire environmental assessment and the conclusions in its FONSI provide a bounding case for Project Partnership. The Sapphire environmental assessment and FONSI are hereby incorporated by reference and provide the basis for analysis in this EA.

The proposed action for Project Partnership is described below followed by a discussion of the similarities and differences between the scope and impacts of this proposed action, and that of Project Sapphire.

2.0 PROPOSED ACTION

2.1 Project Partnership

The proposed action is the transportation of approximately 5 kg uranium via U.S. military aircraft from the Tbilisi, Republic of Georgia to Dounreay, Scotland in the United Kingdom for secure storage. The uranium-23 S consists of less than 5 kg uranium-23 S (^{235}U) in the form of fresh fuel (fuel which has not been used or irradiated in the Tbilisi research reactor) and less than 1 kg of partially-spent fuel. Enriched uranium and the partially-spent fuel would be removed from the current storage location at the research reactor in Tbilisi, repackaged for safe and secure transport, and transported by military C-5 or C-17 aircraft to the United Kingdom in Dounreay, Scotland. DOE would oversee the repackaging and transportation of the material; however all actions would occur in and between foreign countries. None of the material would be returned to the United States and no there would be no physical project (such as a permanent building or other facility) constructed in a foreign country. The United Kingdom would assume responsibility for the fuel once in their possession.

2.2 Enriched Uranium to be Rel9cated

The enriched uranium to be relocated includes 4.3 kg (0.0043 metric tons) of enriched uranium (^{235}U) in the form of fresh fuel (fuel which has not been used in the research reactor at Tbilisi), and 0.959 kg (0.000959 metric tons) of enriched uranium (^{235}U) in the form of partially-spent fuel (fuel which has been used or irradiated in the Tbilisi research reactor, but not completely spent). A description of the type and quantity of fresh fuel and partially-spent fuel is provided in Table 2.2-1. Fresh fuel accounts for the majority of the U-235 to be transported (82% of the total U-235) as shown in Table 2.2-2.

2.3 Repackaging

The Georgian enriched uranium would require repackaging prior to transport because the Georgian containers currently used to store the material do not meet requirements for international transport. The repackaging operations would require approximately 20 DOE and contractor personnel. Actions that would occur on the ground in Georgia (such as repackaging and loading/unloading operations) would be conducted with the full cooperation and involvement of the governments of Georgia and the United Kingdom. These actions conducted in the sovereign nations are not analyzed in this environmental assessment. However, a description of the packaging is provided below as a basis for assessing potential transportation impacts.

Table 2.2-2 ***Percentage Comparison of Fresh Fuel and Partially-Spent Fuel***		
Material Type	*Total U-235 (kg)*	*Percentage U-235 of total quantity U-235*
Fresh Fuel	4.302	82%
Partially-Spent Fuel	0.959	18%
total	5.261	100%

2.3.1 <u>Fresh Fuel</u>

- The packaging to be used would be the U.S. Department of Transportation (DOT) Type B packaging which consists of a DOE-specification 6M (49 CFR 178.354) outer container (a standard 55-gallon or 110-gallon drum) and a DOE-specification 2R steel inner container ([]OT, 1994). These are the same types of packaging used in Project Sapphire as discussed in section 3.2 of the Sapphire environmental assessment. Approximately eight 55-gallon containers and 24 1 10-gallon containers would be used. The 110-gallon container would be used to repackage the longer fuel elements and assemblies. The total weight of the packaged enriched uranium would be approximately 15,160 lbs and would require approximately 210 ft^2 cargo space which is well within the capacity of the military aircraft. The packaged material would be secured in the aircraft using military tie-down procedures such as cargo restraint transporters (CRTs) as discussed in the Sapphire environmental assessment in section 3.5.5.

2.3.2 <u>Partially-Spent Fuel</u>

- The partially-spent (irradiated fuel) would be repackaged into one Nuclear Assurance Corporation, International ~AC) LWT dry-transfer cask. NAC has previously performed packaging and transport of foreign spent fuel; this would not be a new type of job. The NAC LWT cask is the preferred US Nuclear Regulatory Commission (NRC) licensed Type B spent fuel cask and is certified to transport spent fuel by highway, rail, and vessel. The small quantity of irradiated fuel would not require other special physical protection.

The DOT Hazardous Material Regulations provide the basic requirements for domestic transportation of hazardous materials. These regulations recognize that government agencies need to ship radioactive materials outside of the US regulatory arena. Title 49 Code of Federal Regulations (CFR) 173.7 (b) was intended to address this circumstance. Radioactive materials transported by the DoD or DOE for the purpose of national security are not subject to the Hazardous Materials Regulations (49 CFR 171, 173, and 175). DOE has invoked this provision when appropriate and has transported materials safely.

2.3.3 <u>Package Certification and Testing.</u>

Section 3.2 of the Project Sapphire environmental assessment discusses the certification and testing requirements of the packaging. Packaging for this Project Partnership meets the same certification and testing requirements of 49 CFR, and is in accordance with the International Atomic Energy Agency (IAEA) Regulations and is incorporated by reference.

The NAC-LWT cask which would be used to package the partially-spent fuel would meet the requirements of 10 CFR Part 71 which define test conditions that a package must successfully pass. The NRC has issued their Certificate of Compliance (U5AI9225/BF-8 5-Certificate of Compliance) authorizing NAC to use the NAC LWT cask in this project. This Certification of Compliance was based on the document, "NAC International Safety Analysis Report Amendment for NAC LWT Cask." The Certification of Compliance verifies that the cask meets the safety envelope for transporting the five partially-spent fuel assemblies based on the parameters of thermal heat decay, nuclear criticality, dispersion of radioactive isotopes, and radiological dose.

The DOE and DOT would secure necessary foreign approvals with the competent authorities of the foreign nations to use the NAC-LWT cask for transport within their countries.

2.3.4 Nuclear Criticality Considerations.

Nuclear criticality concerns have been analyzed and the appropriate protection measures would be taken in the repackaging operations to ensure a critically-safe configuration during transportation. The number, type, and arrangement of containers would be designed to be safe from nuclear criticality under conditions where the containers might be flooded with water in a hypothetical bounding case accident scenario (Saralidze 1996).

2.4 Air Transport

For the purposes of this environmental assessment, the proposed action begins in the air over the global commons at the boundary of the Republic of Georgia and the Black Sea and concludes with the entry into United Kingdom airspace over Scotland. The global commons involved in the proposed action includes the Black Sea and the North Sea. The United States DoD European Command (EUCOM) would secure the necessary overflight approvals for countries under the proposed flight path. EUCOM would need to select a longer flight path if all overflight approvals were not able to be obtained. This alternative is further discussed in Section 3.1 of this environmental assessment.

The enriched uranium would be transported from Tbilisi, Georgia to Scotland by one United States military C- 17 aircraft under control of EUCOM with an estimated three DoD personnel. A second C- 17 would transport material and equipment needed to support the repackaging and loading/unloading operations. The C-17 is smaller than the C-S which was used in Project Sapphire. The C-17 has a shorter wing span, shorter length, shorter height, less weight, and less engine thrust. EUCOM may choose to use one C-S aircraft for the personnel and enriched uranium and a smaller C- 141 to transport support equipment. This alternative is further discussed in section 3.2 of this environmental assessment.

2.5 Differences Between Project Partnership and Project Sapphire

Because of the similarities between this action and Project Sapphire, the scope of the two projects are compared in Table *2.5-1*. (The potential environmental impacts are compared in Section 5 of this environmental assessment and shown in Table 5.1.1-2.)

The primary differences include the quantity of material and the storage destination. Project Partnership involves transport of less than 1% of the quantity of enriched uranium transported under Project Sapphire. Project Partnership involves no action inside the United States whereas Project Sapphire brought the enriched uranium back to the United States for interim storage (where it was eventually processed into low enriched uranium for use a commercial nuclear fuel). Both Projects Sapphire and Partnership involve nuclear fuel. However, one difference is the inclusion of a small quantity of partially-spent fuel in Project Partnership. This quantity is less than *1/5* of the total amount of enriched uranium that would be transported. However, because Project Sapphire did not involve partially-spent fuel, additional analysis is provided in Section 5 of this environmental assessment.

Table 2.5-1 Comparison of Scope of Project Partnership with Project Sapphire

3.0 ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the proposed action that meet the purpose and need are discussed below in5ections 3.1 through 3.3. Alternatives that do not meet the purpose and need are also mentioned and dismissed in section 3.4. Analysis of these alternatives is provided in Section 5 of this environmental assessment.

Because of the decision of the President of the United States and the leaders of the United Kingdom and the Republic of Georgia to relocate the enriched uranium from Georgia to the United Kingdom, the only alternatives available for further consideration include the method of transport and the transportation route.

3.1 Alternative Flight Path

An alternative transportation route could involve traversing a longer flight path over the global commons of the Mediterranean Sea and the Atlantic Ocean. While this route would pass over fewer countries, the route would be approximately 5510 miles; 5260 miles of which would be over the global commons of the Mediterranean Sea and Atlantic Ocean and only about 250 miles would pass over land. This longer flight route may need to be selected if overflight approvals cannot be obtained for all countries involved if the shortest air route were selected. These countries are listed in the proposed action in section 2.4 of this environmental assessment. Under this alternative, the longer flight path could also require one in-flight refueling.

Table 3.1-1 ***Alternative Flight Paths***

	Short Route: *over Black Sea and North Sea* *(total flight distance in miles)*	***Long Route:*** *over Mediterranean & Atlantic* *(total flight distance in miles)*	*Percentage Flight Over Global Commons*	*Comparison* *with Project Sapphire*
distance over water (global commons)	1,250	5,260	47%	~5,500 miles or about 70%
distance over land	1,400	250	95%	~2,500 miles or about 30%
total	2,650	5,510	--	8,000

3.2 Alternative Transportation Mode

EUCOM may wish to use the larger *C-5* aircraft rather than C-17. Because the *C-5* is larger, all of the enriched uranium and equipment may be able to fit in one *C-5* rather than the two C-17 described under the proposed action (one C-17 for enriched uranium and one C- 17 for support equipment). Use of the larger *C-5* may also require an in-flight refueling if the longer flight path is selected. Under this option, a smaller 141 aircraft may also need to be used to carry ancillary support equipment if it would not all fit on the *C-5*. However, if the aerial port of entry is not capable of receiving the larger *C-5*, this alternative would not be further considered.

3.3 No Action

The No Action alternative is considered as a baseline for assessment of potential impacts. Under the No Action alternative, the enriched uranium would be left in place at Tbilisi with no additional security measures. Because of the unreliable electrical supply, political unrest, and poor security conditions at the facility, this alternative could result in theft or unauthorized access to the enriched uranium. Under the No Action alternative, the United States would not participate in the transport of the Georgian enriched uranium. Either Georgian government would need to find another country to legally obtain the enriched uranium, or the United Kingdom would need to find another transportation agent, or the Georgian officials could invest in further security upgrades, or risk theft of the enriched uranium.

3.4 Alternatives Considered but Dismissed

Prior to the decision to relocate the material from Georgia to the United Kingdom, DOE was considering various alternatives for ports of entry into the United States and various interim storage locations within the United States. However, following the decision of the leaders of the three countries, these alternatives have been eliminated from further consideration. The need for action is to move the enriched uranium to the United Kingdom for storage, not to the United States. Thus the alternatives to be analyzed involve various transportation modes and routes, not destination.

A possible alternative transportation mode could involve military transport by United States Navy ships over the global commons. This mode would require longer time than air transport. The governments of the United Kingdom and the Republic of Georgia have expressed a need to relocate the enriched uranium as quickly as possible, therefore naval transport was not considered as an alternative that would meet the purpose and need for action.

4.0 AFFECTED ENVIRONMENT

The Republic of Georgia and the United Kingdom are cooperating partners with the United States. Countries over which the enriched uranium would be transported would also agree to be cooperating partners through the action of granting overflight approval. As such, the governments of those countries exercise sovereign authority to regulate actions conducted within their jurisdiction. Thus the human environment that would be involved by this proposed action including repackaging and land transportation in Georgia, and unloading, land transportation, and final disposition in the United Kingdom is not required to addressed in this environmental assessment. However, actions that may affect the global commons outside of the jurisdiction of a sovereign nation are analyzed in this environmental assessment. The global commons potentially affected by this action includes the Black and North Seas.

The environmental assessment for Project Sapphire (sections 5.4 and 5.5) briefly described the marine environment with respect to background levels of radiation. Additional information is provided below.

4.1 Marine Environment

Uranium is found to be naturally occurring in the oceans with the uranium series of nuclides contributing about 96% of the total a-activity in seawater. Uranium has a relative high degree of non-reactivity in seawater. *U-235* concentrations vary from 0.04 to 0.07 picocuries per liter (pCi/l). Such naturally-occurring uranium is present in marine organisms at concentrations greater than in terrestrial ecosystems (Mihai 1997). The North Sea is more connected with the open ocean than the Black Sea and therefore would likely be more representative of these baseline conditions than the Black Sea. However, the Black Sea also contains uranium as recorded in sediment samples from both before and after the Chernobyl accident. The concentration of fissionable elements of uranium and thorium in Black Sea sediment samples before Chernobyl was found to range from about 10^{-5} to 10^{-7} gig whereas samples collected after Chernobyl range from about 10^{-5} to $1_0{}^{-6}$ gig (one order of magnitude higher) (Güzel 1997).

4.2 Black Sea

The Black Sea is located in the southeastern corner of Europe, bounded on the north and east by Ukraine, Russia, and Georgia; on the south by Turkey; and on the west by Bulgaria and Romania. The Sea has an area of 420,300 square kilometers (km^2) (168,280 square miles (mi^2)). It is 750 mi (1,200 km) at is greatest extent and has a maximum depth of 2,210 meters (7,250 feet) (Sheskin 1997).

The drainage basin of the Black Sea encompasses almost one third of the entire land area of continental Europe and results in a substantial quantity of surface runoff such as suspended solids and other nutrient and contaminant loading.

The Black Sea is connected to the Mediterranean only by the narrow Bosporus Channel on its south west shore and therefore, the volume exchange of water in the sea (the residence time) is long -- on the order of 20 to *50* years (Sekulic 1997). The Black Sea is relatively tideless, but storms can occur quickly (thus named "Karadeniz" or "black sea" by the Turks) (Grolier 1997).

Surface runoff contributes to a nutrient-rich (eutrophic) environment which consumes virtually all dissolved oxygen in a zone from about *150* to 200 meters deep where high concentrations of hydrogen sulfide exist. Coupled with the weak vertical mixing at these depths, this zone of the sea is virtually without life (Sekulic 1997).

Although marine life has been adversely affected by human activities and surface runoff, the surface waters support a diverse marine life (Georgia 1997) and oysters, mollusks, and fish live and are harvested commercially (Sheskin 1997) although the fisheries have declined because of over fishing and pollution (Sheskin 1997). The Sea remains economically important to the multi-country region as a trade route, tourist attraction, and a fishing area (Sekulic 1997, and Sheskin 1997).

Integrated resource management for the Black Sea is governed under the Convention on the Protection of the Black Sea Against Pollution as adopted in April 1992 and enacted in January 1994 (Green Globe 1997). The United Nations Environmental Programme (UNEP) has also established the Black Sea Environmental Programme to improve the capacity of Black Sea countries to assess and manage the Black Sea environment (UNEP 1997).

4.3 North Sea

The North Sea is a semi-enclosed sea in the north-east Atlantic between Great Britain and the continent of Europe bordered by Belgium, Denmark, France, Germany, the Netherlands, Norway, Sweden, and the United Kingdom. The Sea covers an area of about 570,000 square kilometers (km^2). The North Sea is relatively shallow with an average depth of only about 94 meters (308 feet) with an increasing depth northwards and areas of depths more than 730 meters (2,400 feet).

The drainage basin of the North Sea encompasses 832,000 km2 and contributes to substantial surface runoff (Ducrotoy 1997).

The North Sea is connected to the Atlantic Ocean by the English Channel to the south and the between the Orkney Islands and Norway to the north. Water circulation in the North Sea generally follows a counterclockwise gyre (general circulation pattern) driven by the south-flowing waters from the North Atlantic (entering from the Norwegian Sea), the northeasterly current entering from the English Channel, and the Baltic Current. Coupled with the shallow depths, these currents make the sea turbulent and especially subject to the effect of winter gales (Grolier 1997). The residence time of the North Sea waters is about one to two years making it relatively well-flushed, however human induced impacts are observed and include impacts from the petrochemical industry and surface runoff (Ferm, 1996).

The North Sea is of major economic importance to the European community with a productive fishery and the vast petroleum and natural-gas deposits which have been extracted since the 1970s (Grolier 1997).

Protection of the North Sea is governed by many regional agreements such as the Convention for the Protection of the Marine Environment in the North Atlantic signed in 1992 under the auspices of the Oslo and Paris Commission, and the 1996 Protocol of the London Convention (which bans sea dumping of radioactive wastes) (Ducrotoy 1997).

5.0 Potential Environmental Impacts of the Proposed Action and Alternatives

Potential environmental impacts within sovereign nations are not addressed in this environmental assessment. Only potential impacts to the environment, including the human environment, that would occur in or over the global commons are analyzed. Potential impacts to the human environment from the alternatives are also discussed.

5.1 Air Transport: Normal Operations

Under incident-free conditions, the Sapphire environmental assessment (section 6.2.1.1) analyzed the potential impacts to the crew on the military C-5 aircraft and to the global commons. In incident-free conditions, radiological exposure would only result to the crew on board the aircraft; there would be no radiological exposure to the public.

5.1.1 <u>Incident-Free Radiological Exposure to Workers.</u>

The environmental assessment for Project Sapphire (section 6.2.1.1) analyzed potential impacts to the crew on board the aircraft transporting the enriched uranium. Using the computer code, RADTRAN, the maximum individual dose to the crew was calculated to be 0.01 rem. This dose would be in addition to background dose of 0.015 rem resulting from normal exposure to cosmic radiation on the round-trip flight. A maximum collective dose to 34 crew persons on board was calculated to be 0.34 person-rem. Using the dose-to-risk conversion factor of 4×10^{-4} latent cancer fatalities, the collective dose of 0.34 person-rem would result in 1.4×10^{-4} latent cancer fatalities (0.34 person-rem x 0.0004 risk factor = 0.00014). This potential impact was associated with the transport of 566 kg enriched uranium. The proposed action in Project Partnership would only transport about 5 kg enriched uranium which is about 0.9% of that total quantity of Project Sapphire. However, because Project Partnership involves partially-spent (irradiated) fuel, additional analysis was conducted to determine the potential radiological impact to the workers.

As shown in Table 5.1.1-1, for the proposed transport of 5.261 kg enriched uranium, the unit dose to a singe crew member would be 4.12×10^{-3} rem. Most of this dose would result from the partially-spent fuel. EUCOM estimates that there would be a total of three crew members. Assuming a bounding case of approximately 30 personnel on board the C-17 aircraft, the collective dose to these 30 crew members would be 0.1236 person-rem. Using the dose-to-risk conversion factor of 4×10^{-4} latent cancer fatalities, the collective dose of 0.12 person-rem would result in 4.9×10^{-5} latent cancer fatalities (0.12 person-rem x 0.0004 risk factor =0.000048). If only three crew members were involved, their collective dose would be 0.01236 with a risk of latent cancer fatalities at 4.9×10^{-6} (one order of magnitude less risk). This risk from the bounding case would be about one order of magnitude less than that for Project Sapphire as shown in Table 5.1.1-2.

Under the no action alternative, there would be no flight and therefore, no effects.

Table 5.1.1-1 Incident-Free Radiological Exposure to Crew on Aircraft

Under the alternative of a longer flight path, the in-flight distance would be approximately doubled. As a bounding assumption, the radiological dose to the crew would therefore be doubled. The estimated total collective dose to a bounding case of 30 crew would therefore be 0.2472 person-rem with a probability of a latent cancer fatality at 9.89×10^{-5}. Under the proposed action of three crew (for the shorter route), the collective dose would be 0.025 person-rem with a probability of a latent cancer fatality at $9.89 \times l0^{-6}$ one order of magnitude less risk). These data are shown in Table 5.1.1-1.

5.1.2 <u>Incident-free Non-Radiological Impacts to the Global Commons.</u>

Under incident-free conditions, the Sapphire environmental assessment (section 6.2.1.1) analyzed non-radiological air emissions of criteria air pollutants from the C-5 and refueling aircraft. Emissions of carbon monoxide, nitrogen oxides, hydrocarbons, and particulate matter would fall well below US EPA threshold levels and would not have a measurable effect on the global commons of the air. The Finding of No Significant Impact for Project Sapphire concluded there would be negligible effect on the global commons from the operation of the C-5 aircraft flight over its flight distance of 8,000 miles. Since this action under Project Partnership has approximately 1/3 to % the flight distance, impacts would likewise be negligible.

An alternative flight path over a greater expanse of the global commons would have the same impacts as discussed above with slightly higher, but negligible, emissions from the aircraft operations.

Under the no action alternative, there would be no flight and therefore, no effects.

5.2 Air Transport: Bounding Case Accident Scenario

A bounding case accident scenario would involve an in-flight crash of the military aircraft such that the containers would be breached and the enriched uranium released into the water of the global commons (the Black Sea or the North Sea). As documented in the Sapphire EA (Section 6.2.1.2.1), in-flight accidents would have a higher probability of container breach than landing/stall accidents. Further, for the global commons, only in-flight accidents probabilities are applicable because no landings would occur in the commons. Salvage techniques are assumed to allow for recovery of packages at depths of up to 200 meters ([)OE/EA-0841 and DOE/EA-1006). Should an unbreached package sink below 200 meters, some containment would be expected due to the low corrosion rates of the stainless-steel used in the package's construction. In the Black Sea, due to the anoxic conditions at the below 200m, the lack of oxygen would accelerate corrosion of the uranium. However, because there is no life in this deep zone of the Black Sea, there would be no impacts to the benthic (bottom) species. In the North Sea, which is more shallow, but more well-mixed, the volume of water coupled with the turbulence and mixing of the water column would result in only very localized and negligible impacts. The small quantity of plutonium *(2.65* g) would be expected to preferentially bind with bottom sediments rather than remaining dissolved(DOE/EA-084 1).

The environmental assessment for Project Sapphire (Section 6.2.1.2) examines this bounding case accident scenario for 566 kg of enriched uranium. For Project Sapphire, the probability of the accident occurring in-flight was estimated to be 6.7 x 10^{-10}. This is a bounding conservative probability (overestimation) based on a severe case accident where the impact forces exceed standards and fire engulfs the plane for more than 30 minutes causing 70% of the packages to fail. The accident probability is also based on an aircraft smaller than the C-5. For this reason, the probability is also applicable to this Project Partnership because of the use of the smaller C-17 aircraft.

Based on these assumptions for a bounding case accident scenario, the Project Sapphire Finding of No Significant Impact concludes there may be some loss of life to marine organisms directly exposed to the enriched uranium in this hypothetical bounding case scenario. However, as a result of the large volumes of water, the mixing mechanisms within it, the existing background concentrations of uranium, and the radiation-resistance of aquatic organisms, the radiological and toxicological impact of a very low probability accident would be localized and of short duration. The potential impacts of about 5 kg enriched uranium from Project Partnership would be substantially less than those negligible effects of Project Sapphire which involved 566 kg enriched uranium.

Under the no action alternative, there would be no flight and therefore, no effects.

Under the alternative of a longer flight path, and/or use of a C-5 rather than the C-17, the probability of an accident remains as bounded by the analysis in Project Sapphire. Potential impacts remain the same and neither the public nor the global commons would be affected by any of these alternatives.

5.3 Comparison of Alternatives

The alternatives of the proposed action, no action, and an alternative flight path and crew size are compared in Table 5.3-1.

>If a longer flight path is needed, an in-flight refueling may be necessary. In-flight refueling is discussed in the Project Sapphire environmental assessment in section 6.2.1.2.1 and is considered in the assumptions for the accident analysis.

5.4 Cumulative Impacts

Potential cumulative impacts include impacts from past, present, and reasonably foreseeable future actions. There would be no cumulative impacts. to the public from this action. Potential cumulative impacts to workers are discussed below. As a bounding case, it is assumed (but not likely) that the same crew members who flew Project Sapphire would be the same crew members exposed for Project Partnership. Their cumulative doses are presented in Table 5.4-1. The calculations assume bounding conditions (such as 30 crew and the longer flight path for Project Partnership). The cumulative dose is additive. The cumulative latent cancer fatality was re-calculated from the additive collective dose.

Table 5.3-1 Comparison of Alternatives in Project Partnership

Table 5.4-1 ***Cumulative Bounding Radiological Impacts to Crew***

from Project Partnership and Project Sapphire

	Project Partnership	Project Sapphire	Cumulative Bounding

					Dose	
	collective dose (person-rem)	latent cancer fatality	collective dose (person-rem)	latent cancer fatality	collective dose (person-rem)	latent cancer fatality
dose to crew (bounding)	0.25	9.89×10^{-5}	0.34	1.4×10^{-4}	0.59	2.36×10^{-4}

5.5 Comparison of Impacts Between Projects Partnership and Sapphire

Table 5.5-1 shows the primary differences in potential impacts that would result from Project Partnership as compared with Project Sapphire. All potential impacts would be less than those of Project Sapphire because of the smaller quantity of material in this project, and the shorter air-flight distance. There would also be no impacts to any United States facility and as there was in Project Sapphire. In a bounding case, radiological doses to the crew members in this project would be about 75% less than doses from Project Sapphire and the risk of a latent cancer fatality would be from one to two orders of magnitude less.

Table 5.5-1 Comparison of Potential Environmental Impacts of Project Partnership with Project Sapphire

6.0 AGENCIES CONSULTED

U.S. Department of State

U.S. Department of Defense

Republic of Georgia

United Kingdom

REFERENCES

Columbia 1994 The Concise Columbia Electronic Encyclopedia, Third Edition. Columbia University Press.1994. "Black Sea."Available on-line: http ://www. encyclopedia. com/articles/O1545 .html.

DOE/EA-0841 U.S. Department of Energy (DOE). *Environmental Assessment of the Import of Russian Plutonium-238.* Office of Nuclear Energy. May 1993.

DOE/EA-1006 U.S. Department of Energy (DOE). *Environmental Assessment for the Interim Storage of Highly Enriched Uranium at the Y-12 Plant, Oak Ridge, Tennessee Acquired from Kazakhstan by the United States.* DOE/EA 1006. Office of Nonproliferation and National Security and the Office of Defense Programs. October 1994. Available on-line:

http://web.fie.com/htdoc/fed/doe/fsllpubltext/any/rep27.htm. The Finding of No Significant Impact (FONSI) for this EA is available on-line: http://web.fie.com/htdoc/fed/doe/fsl/pub/text/any/rep26.htm.

DOE/EA-1063 U.S. Department of Energy (DOE). *Environmental Assessment for the Disposition of Highly Enriched Uranium Obtained from the Republic of Kazakhstan.* DOEIEA-1063. May 1995. Available on-line: http://web.fie.com/htdoc/fed/doe/fsl/pub/text/any/rep3**7**.htm The Finding of No Significant Impact (FONSI) for this EA is also available on-line: http://http :I/web.fie.com/htdoc/fedldoe/fsilpub/text/any/rep3 7.htm

Ducrotoy 1997 Ducrotoy, Jean-Paul; and Elliott, Michael. "Interrelations between Science and Policy-making: the North Sea Example." *Marine Pollution Bulletin.* Vol. 34, No. 9, pp. 686-701. Elsevier Sciences, Ltd. Great Britain. September

1997.

Ferm 1996 Ferm, Ronny. "Assessing and managing man-made impacts on the marine environment -- the North Sea example." *The Science of the Total Environment.* Vol 186, pp.3-il. Elsevier Science. Great Britain. 1996.

Georgia 1997 "State of the Environment Georgia - The Black Sea." Fact Sheets published by the Republic of Georgia on environmental issues. Available on-line: http ://www.grida.no/prog/cee/enrin. . . geor/english/blacksea/blacksea.htm.

Green Globe 1997 Green Globe Yearbook 1997. *Convention on the Protection of the Black Sea Against Pollution.* April 21, 1992. Bucharest. Available on-line: http *:I/www.* ext.grida.no/ggynet/agree/mar-env/blacksea.html.

Grolier 1997 Glolier Encyclopedia on CD ROM. "North Sea." 1997.

Güzel 1997 Güzel, T, *et al.* "Determination of concentration of fissionable elements in the Black Sea sediment samples before and after Chernobyl using neutron radiography method." *Radiation Measurements.* Vol.28, Nos 1-6, pp.405-408. Elsevier Science, Ltd. Great Britain. 1997.

Mihai 1997 Mihai, S.A., Shaw, G., Georgescu, 1.1., and Hartgen, C. "Correlated concentration distributions of natural alpha-radionuclides in sediment samples along the Romainian sector of the Danube river and the Black Sea coast." *Journal of Radioanalytical and Nuclear Chemistry.* Vol.221, No.1-2, pp. 203-205. March.1997.

Riedy 1996 *Project Olympus. Options for the Repackaging and Transport of Nuclear Fuel from* an *IRT-M Reactor in Tbilisi, Georgia.* Lockheed Martin Energy System International Policy and Analysis Division, Office of Arms Control and Nonproliferation. U.S. Department of Energy. (KINSP-357). April 2, 1996.

Saralidze 1996 Saralidze, Abramidze, and Kiknadze. "Criticality Study for Possible Repacking and Relocation of Nuclear Materials Existing at the Applied Research Center of the Institute of Physics." Institute of Physics of the Academy of Sciences of Georgia. Tbilisi, Republic of Georgia. August 27, 1996.

Sekulic 1997 Sckulic B., and Vertacnik A. "Comparison of anthropological and "natural" input of substances through waters into Adriatic, Baltic and Black Sea." *Water Research.* Vol 31, NO 12, pp.3178-3182. Elsevier Science. Ltd. Great Britain. 1997.

Sheskin 1997 Sheskin, Ira M. "Black Sea." Grolier Encyclopedia on CD-ROM. 1997.

UNEP 1997 United National Environmental Programme (UNEP). "The Black Sea Environmental Programme." Fact Sheet. Available on-line: http ://www.parliament.ge/SOEGEO/english/blacksea/bsep.html.

White House 1993 White House, Office of the Press Secretary. *Nonproliferation and Export Control Policy.* Fact Sheet. September 27, 1993.

[1]Tbilisi is one of thirteen Districts in the Republic of Georgia which is a Newly Independent State of the Former Soviet Union.

[2]These teams routinely conduct surveillance of foreign nuclear facilities in conjunction with the International Atomic Energy Agency (IAEA) to verify adequate safeguards, security, and accountability of nuclear materials.

[3] The term, "fresh nuclear fuel" means nuclear fuel that has not been "spent" or irradiated by use in a nuclear reactor.

[4]The HEU was later removed from interim storage at Y- 12 and transferred to the Babcock & Wilcox facility in Lynchburg, Virginia and the Nuclear Fuel Services facility in Erwin, Tennessee for blending into Low Enriched Uranium (LEU).

[5] DOE prepared a separate EA for the disposition of the Kazakhstan HEU in May 1995 (DOE/EA- 1063) which resulted in a Finding of No Significant Impact (FONSI) in May 1995.